AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS

1.   (Currently amended)   A method for automatically determining a structure cancelled image in a dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of at least **the** first and second types of structure at an energy level lower than the first energy level image;

computing a characteristic mask using the low energy level image **and by comparing one or more pixels of a gradient mask to one or more corresponding pixels of a localization mask**;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second cancellation

parameter.

2.   (Currently amended) ~~The method of claim 1, further comprising:~~

A method for automatically determining a structure cancelled image in a

dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

generating a gradient mask from a ratio of the high to low energy images, at least

one of the high and low energy images being adjusted based on ~~the~~ first or second

cancellation parameter~~s~~, wherein the gradient mask is used when automatically

computing the first or second cancellation parameter;

computing a characteristic mask using the low energy level image;

evaluating the first cancellation parameter against the characteristic mask;

computing the second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter.

3.   (Currently amended)   ~~The method of claim 2, further comprising:~~

A method for automatically determining a structure cancelled image in a

dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

compressing the high and low energy level images used to generate the gradient

mask**;**

generating a gradient mask from a ratio of the high to low energy images, at

least one of the high and low energy images being adjusted based on ~~the~~ **first or**

second cancellation parameters, wherein the gradient mask is used when

automatically computing the first or second cancellation parameter;

computing a characteristic mask using the low energy level image;

evaluating the first cancellation parameter against the characteristic mask;

computing the second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter.

4.   (Currently amended)   ~~The method of claim 1, further comprising:~~

A method for automatically determining a structure cancelled image in a

dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

generating a gradient image based on the high and low energy images; ~~and~~

comparing the gradient image with a gradient threshold to form a gradient mask,

wherein the gradient mask is used when automatically computing the first or second

cancellation parameter;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter.

5.   (Currently amended)   ~~The method of claim 1,~~ **A method for**

automatically determining a structure cancelled image in a dual energy

decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter,

wherein said step of computing a characteristic mask further comprises:

convolving a Sobel operator with an image based on the low energy level

and the high energy level images to form a gradient image;

selecting a predetermined gradient threshold automatically from a set

based upon a selected diagnostic application; and

creating the gradient mask by comparing the gradient image to the

gradient threshold and assigning a first identifier to any image pixel greater than

the gradient threshold and a second identifier to any image pixel less than the

gradient threshold.

6.   (Original)   The method of claim 1, wherein the cancellation equation

represents a relationship between the high energy image and the low energy image

adjusted according to the first or second cancellation parameter.

7.   (Original)   The method of claim 1, wherein the first or second

cancellation parameter is selected from a predetermined range in a look-up table, the

range being determined by an effective kVp used to acquire the high level image and an

effective kVp used to acquire the low level image.

8.   (Currently amended)   ~~The method of claim 1,~~ **A method for**

automatically determining a structure cancelled image in a dual energy

decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter,

wherein the cancellation equation is:

$$I_s(x,y) = I_{HIGH}(x,y) / (I_{LOW}(x,y))^{ws},$$

and w_s is the first cancellation parameter, I_{HIGH} is the high energy level image, and

I_{LOW} is the low energy level image.

9.   (Currently amended) ~~The method of claim 1,~~ **A method for**

automatically determining a structure cancelled image in a dual energy

decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter,

wherein the cancellation equation is:

$$I_b(x,y) = I_{HIGH}(x,y) / (I_{LOW}(x,y))^{wb},$$

and w_b is the second cancellation parameter, I_{HIGH} is the high energy level image,

and I_{LOW} is the low energy level image.

10.   (Currently amended)   ~~The method of claim 1, further comprising:~~

A method for automatically determining a structure cancelled image in a

dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

generating a localization image based on the low energy image; ~~and~~

comparing the localization image with an intensity threshold to form a

localization mask, wherein the localization mask is used when automatically computing

~~the~~ first or second cancellation parameter**s;**

computing a characteristic mask using the low energy level image;

evaluating the first cancellation parameter against the characteristic mask;

computing the second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter.

11.   (Currently amended) ~~The method of claim 10,~~   **A method for**

automatically determining a structure cancelled image in a dual energy

decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

generating a localization image based on the low energy image;

comparing the localization image with an intensity threshold to form a

localization mask, wherein the localization mask is used when automatically

computing first or second cancellation parameters;

computing a characteristic mask using the low energy level image;

evaluating the first cancellation parameter against the characteristic mask;

computing the second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter;

wherein the comparing step further comprises:

selecting the predetermined intensity threshold automatically from a set

based upon said selected diagnostic application.

12.   (Currently amended)   ~~The method of claim 1,~~ **A method for**

automatically determining a structure cancelled image in a dual energy

decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter,

wherein the step of computing the characteristic mask further comprises:

computing a gradient mask;

computing a localization mask; and

creating the characteristic mask by comparing pixels of the gradient mask

to corresponding pixels of the localization mask and assigning a second identifier

to the corresponding pixel of the characteristic mask if the corresponding pixels of

the gradient mask and the localization mask are equal.

13.   (Original)   The method of claim 1, wherein the computing the

characteristic mask step further comprises:

assigning a first value to pixels representing only hard structure in the low energy

level image; and

assigning a second value to pixels representing only soft structure in the low

energy level image.

14.   (Currently amended) ~~The method of claim 1,~~ __A method for__

__automatically determining a structure cancelled image in a dual energy__

__decomposition system, the method comprising:__

__obtaining a first high energy level image of internal anatomy formed of at__

__least first and second types of structure;__

__obtaining a second low energy level image of the internal anatomy formed of__

__at least the first and second types of structure at an energy level lower than the first__

__energy level image;__

__computing a characteristic mask using the low energy level image;__

__evaluating a first cancellation parameter against the characteristic mask;__

__computing a second cancellation parameter based on the first cancellation__

__parameter; and__

__obtaining a structure cancelled image from the first and second energy level__

__images according to a cancellation equation using one of the first and second__

__cancellation parameter,__

wherein the evaluating step further comprises:

generating a series of gradient maps utilizing the cancellation equation and

high and low energy level images by adjusting the first cancellation parameter to

a value having a maximum likelihood of emphasizing the first type of structure.

15.   (Currently amended) ~~The method of claim 1,~~ **A method for**

automatically determining a structure cancelled image in a dual energy

decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter; and

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter,

wherein the evaluating step further comprises:

computing multiple gradient maps using a range of cancellation

parameters from a look up table; and

determining a lowest gradient value for each pixel location by comparing

corresponding pixel locations of the multiple gradient maps to each other and

identifying an associated cancellation parameter for each of the identified lowest

gradient values.

16.   (Currently amended) ~~The method of claim 15, further comprising:~~

A method for automatically determining a structure cancelled image in a

dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter;

creating a histogram comprised of cancellation parameters associated with the

lowest gradient values derived from the characteristic mask; ~~and~~

identifying a cancellation parameter occurring at the peak of the histogram as the

value of the cancellation parameter having the maximum likelihood of canceling the first

type of structure; **and**

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter,

wherein the evaluating step further comprises:

computing multiple gradient maps using a range of cancellation

parameters from a look up table; and

determining a lowest gradient value for each pixel location by

comparing corresponding pixel locations of the multiple gradient maps to

each other and identifying an associated cancellation parameter for each of

the identified lowest gradient values.

17.   (Currently amended)   ~~The method of claim 15, further comprising:~~ A

method for automatically determining a structure cancelled image in a dual energy

decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at

least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of

at least the first and second types of structure at an energy level lower than the first

energy level image;

computing a characteristic mask using the low energy level image;

evaluating a first cancellation parameter against the characteristic mask;

computing a second cancellation parameter based on the first cancellation

parameter;

identifying a value of the cancellation parameter having the maximum likelihood

of emphasizing the first type of structure by calculating a mean of the cancellation

parameters associated with the lowest gradient values derived from the characteristic

mask**; and**

obtaining a structure cancelled image from the first and second energy level

images according to a cancellation equation using one of the first and second

cancellation parameter,

wherein the evaluating step further comprises:

computing multiple gradient maps using a range of cancellation

parameters from a look up table; and

determining a lowest gradient value for each pixel location by

comparing corresponding pixel locations of the multiple gradient maps to

each other and identifying an associated cancellation parameter for each of

the identified lowest gradient values.

18.   (Original)   The method of claim 1, further comprising:

computing a hard structure cancelled image and a soft structure cancelled image

using the cancellation equation, the first cancellation parameter and the second

cancellation parameter.

19.   (Original)   The method of claim 1, wherein the second cancellation

parameter is linearly related to the first cancellation parameter.

20.   (Original)   The method of claim 1, wherein said step of obtaining a

structure cancelled image further comprises:

obtaining a first structure cancelled image from the first and second energy level

images according to the cancellation equation using the first cancellation parameter; and

obtaining a second structure cancelled image according to the cancellation

equation using the second cancellation parameter.

21.   (Currently amended) A method for automatically determining a structure

cancelled image in a dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at least

first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of at

least **the** first and second types of structure at an energy level lower than the first energy

level image;

computing a gradient mask identifying a characteristic of interest from the

internal structure based on a predefined cancellation parameter;

localizing the characteristic of interest from the gradient mask based on a

constraint parameter to form a characteristic mask;

at selected pixel locations in the characteristic mask, varying the cancellation

parameter over a range and obtaining for each selected pixel the cancellation parameter

value yielding a desired characteristic mask value; and

determining a maximum likelihood estimate of a single value for the cancellation

parameter.

22.   (Original)   The method of claim 21, wherein the computing step

includes computing the gradient mask for the first and second energy level images using

an edge cancellation parameter and a gradient threshold.

23.   (Original)   The method of claim 21, wherein the localizing step is

based on an intensity threshold placed on the second energy level image.

24.   (Original)   The method of claim 21, wherein the varying step includes incrementally stepping the cancellation parameter between upper and lower parameter limits and, at each discrete value for the cancellation parameter, calculating a gradient value.

25.   (Original)   The method of claim 21, further comprising:

constructing a histogram of all pixel locations of interest from the characteristic mask.

26.   (Currently amended)   A method for automatically determining a structure cancelled image in a dual energy decomposition system, the method comprising:

obtaining a first high energy level image of internal anatomy formed of at least first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of at least the first and second types of structure at an energy level lower than the first energy level image;

automatically computing a cancellation parameter having a maximum likelihood of canceling one of the first and second types of structure from a structure cancelled image; and

generate the structure cancelled image based on a cancellation equation using the

automatically computed cancellation parameter, the structure cancelled image

emphasizing the first types of structure and de-emphasizing the second type of structure.

27.　　(Original)　　The method of claim 26, further comprising:

computing a characteristic mask storing a first identifier at each pixel location

corresponding to the first type of structure.

28.　　(Original)　　The method of claim 26, further comprising:

determining a characteristic mask storing a pattern of pixel values defining an

image outline for the first type of structure.

29.　　(Original)　　A method for automatically determining a structure

cancelled image in a dual energy decomposition system, the method comprising:

utilizing a pre-computed look-up table of cancellation parameters for anatomies at

various high and low energy pairs;

obtaining a first high energy level image of internal anatomy formed of at least

first and second types of structure;

obtaining a second low energy level image of the internal anatomy formed of at least the first and the second types of structure at an energy level lower than the first energy level image; and

obtaining a structure cancelled image from the first and the second energy level images according to a cancellation equation using the appropriate cancellation parameter from said look-up table.